4) $\Delta_\eta \delta_\alpha \Pi^{int} = \int_{B_0} \delta_\eta \underline{\underline{E}}_E : \hat{\underline{\underline{C}}}_E : \Delta_\eta \underline{\underline{E}}_E + \hat{\underline{\underline{S}}}_E : \Delta_\eta \delta_\alpha \underline{\underline{E}}_E \, dV$

- $\hat{\underline{\underline{S}}}_E : \Delta_\eta \delta_\alpha \underline{\underline{E}}_E = \hat{\underline{\underline{S}}}_E : \Delta_\eta \left[(\underline{\underline{F}}_0 \delta_\alpha \bar{\underline{\underline{F}}})^T \underline{\underline{F}}_E \right] = \hat{\underline{\underline{S}}}_E : (\underline{\underline{F}}_0 \delta_\alpha \bar{\underline{\underline{F}}})^T \underline{\underline{F}}_0 \Delta_\eta \bar{\underline{\underline{F}}}$

$= \underline{\underline{F}}_0 \delta_\alpha \bar{\underline{\underline{F}}} \, \hat{\underline{\underline{S}}}_E : \underline{\underline{F}}_0 \Delta_\eta \bar{\underline{\underline{F}}}$

FE: $\underline{\underline{K}}^e_{\eta\alpha,mI} = \int_{\hat{\Omega}} \underline{B}^T_{M,E} \hat{\underline{\underline{C}}}_{E,0} \underline{B}_{M,Ej} \, d\hat{\Omega}$

$\delta \alpha_A \underline{\underline{K}}^{e,AB}_{\alpha\alpha,geom} \Delta \alpha_B = \delta \alpha_A \int_{\hat{\Omega}} \underline{\underline{F}}_0 \underline{\underline{M}}_A \hat{\underline{\underline{S}}}_E : \underline{\underline{F}}_0 \underline{\underline{M}}_I \, d\hat{\Omega} \, \Delta q_I$

Static Condensation

$$\begin{bmatrix} \underline{\underline{K}}^e_{\varphi\varphi} & \underline{\underline{K}}^e_{\varphi\alpha} \\ \underline{\underline{K}}^{eT}_{\varphi\alpha} & \underline{\underline{K}}^e_{\alpha\alpha} \end{bmatrix} \begin{bmatrix} \Delta \underline{\varphi}^e \\ \Delta \underline{\alpha}^e \end{bmatrix} = - \begin{bmatrix} \underline{R}^e_\varphi \\ \underline{R}^e_\alpha \end{bmatrix}$$

$\Rightarrow \Delta \underline{\alpha}^e = - (\underline{\underline{K}}^e_{\alpha\alpha})^{-1} (\underline{R}^e_\alpha + \underline{\underline{K}}^{eT}_{\varphi\alpha} \Delta \underline{\varphi}^e)$ → update

$\Rightarrow \underbrace{(\underline{\underline{K}}^e_{\varphi\varphi} - \underline{\underline{K}}^e_{\varphi\alpha} (\underline{\underline{K}}^e_{\alpha\alpha})^{-1} (\underline{\underline{K}}^e_{\varphi\alpha})^T}_{\underline{\underline{K}}^e} \Delta \underline{\varphi}^e = - \underbrace{(\underline{R}^e_\varphi - \underline{\underline{K}}^e_{\varphi\alpha} (\underline{\underline{K}}^e_{\alpha\alpha})^{-1} \underline{R}^e_\alpha)}_{\underline{R}^e}$

$= - \underline{\underline{K}}^{-1}_{\alpha\alpha} \underline{R}_\alpha - \underline{\underline{K}}^{-1}_{\alpha\alpha} \underline{\underline{K}}^T_{\varphi\alpha} \Delta \underline{\varphi}$

RSe KSe

$\Delta \alpha = - RSe - KSe \cdot input$

Dokumentieren